

WHAT IS CLAIMED IS:

- 1 1. A method for making a series of nanoscale microstructures comprising the steps of:
 - 2 (1) forming a block copolymer containing a plurality of first polymer blocks and a
3 plurality of second polymer blocks, wherein at least said first polymer blocks are chiral
4 polymer blocks exhibiting chirality, and said first and second polymer blocks are
5 capable of being subject to a micro-phase separation and said first polymer blocks
6 have a volume fraction ranging from 10 to 90%;
 - 7 (2) causing a microphase separation in said chiral block copolymer.
- 1 2. The method for making a series of nanoscale microstructures according to claim 1, wherein
2 said chiral block copolymer is poly(styrene)-poly(L-lactide) (PS-PLLA) chiral block
3 copolymer, said first polymer is poly(L-lactide), and said second polymer is polystyrene.
- 1 3. The method for making a series of nanoscale microstructures according to claim 1, wherein
2 said chiral block copolymer is poly(4-vinylpyridine)-poly(L-lactide) (P4VP-PLLA) chiral
3 block copolymer, said first polymer is poly(L-lactide), and said second polymer is pol(4-
4 vinylpyridine).
- 1 4. The method for making a series of nanoscale microstructures according to claim 1, wherein
2 said poly(L-lactide) has a volume fraction ranging from about 20% to about 49%.
- 1 5. The method for making a series of nanoscale microstructures according to claim 1, wherein
2 said nanoscale microstructures are a series of helical microstructures.
- 1 6. The method for making a series of nanoscale microstructures according to claim 1, wherein

2 said nanoscale microstructures are a series of cylindrical microstructures each with a
3 hexagonal crossection.

1 7. The method for making a series of nanoscale microstructures according to claim 2, wherein
2 said poly(styrene)-poly(L-lactide) (PS-PLLA) chiral block copolymer is prepared using a
3 polymerization process comprising the following steps:

4 (1) mixing styrene with BPO and 4-OH-TEMPO to form 4-hydroxy-TEMPO-terminated
5 polystyrene; and

6 (2) mixing said 4-hydroxy-TEMPO-terminated polystyrene with $[(\eta_3\text{-EDBP})\text{Li}_2][(\eta_3\text{-}$
7 $\text{"Bu})\text{Li}(0.5\text{Et}_2\text{O})]_2$ and L-lactide in an organic solvent to form said poly(styrene)-
8 poly(L-lactide) chiral block copolymer.

1 8. The method for making a series of nanoscale microstructures according to claim 7, wherein
2 said polymerization process is a living polymerization in which monomers are sequentially
3 added to a polymerization mixture.

1 9. The method for making a series of nanoscale microstructures according to claim 1, wherein
2 said phase separation of said poly(styrene)-poly(L-lactide) chiral block copolymer is achieved
3 through crystallization.

1 10. An object containing a series of repeating nanoscale microstructures formed in a substrate,
2 said objected being formed using a process comprising the steps of:

3 (1) forming a block copolymer containing a plurality of first polymer blocks and a
4 plurality of second polymer blocks, wherein said first polymer blocks are chiral
5 blocks, wherein said first polymer blocks have a volume fraction ranging from 10 to
6 90%;

7 (2) causing a phase separation in said block copolymer.

1 11. The method for making a series of nanoscale microstructures according to claim 11, wherein
2 said block copolymer is a poly(styrene)-poly(L-lactide) chiral block copolymer, and said first
3 polymer blocks are poly(L-lactide) blocks and said second polymer blocks are polystyrene
4 blocks.

1 12. The method for making a series of nanoscale microstructures according to claim 11, wherein
2 said block copolymer is a poly(4-vinylpyridine)-poly(L-lactide) chiral block copolymer, and
3 said first polymer blocks are poly(L-lactide) blocks and said second polymer blocks are
4 poly(4-vinylpyridine) blocks.

1 13. The method for making a series of nanoscale microstructures according to claim 9, wherein
2 said poly(L-lactide) has a volume fraction ranging from about 20% to about 49%.

1 14. The method for making a series of nanoscale microstructures according to claim 11, wherein
2 said nanoscale microstructures are a series of helical microstructures.

1 15. The method for making a series of nanoscale microstructures according to claim 11, wherein
2 said nanoscale microstructures are a series of cylindrical microstructures each with a
3 hexagonal crosssection.

1 16. The method for making a series of nanoscale microstructures according to claim 12, wherein
2 said poly(styrene)-poly(L-lactide) (PS-PLLA) chiral block copolymer is prepared using a
3 polymerization process comprising the following steps:

4 (1) mixing styrene with BPO and 4-OH-TEMPO to form 4-hydroxy-TEMPO-terminated

5 polystyrene; and

6 (2) mixing said 4-hydroxy-TEMPO-terminated polystyrene with $[(\eta_3\text{-EDBP})\text{Li}_2][(\eta_3\text{-}$
7 $\text{"Bu})\text{Li}(0.5\text{Et}_2\text{O})]_2$ and L-lactide in an organic solvent to form said poly(styrene)-
8 poly(L-lactide) chiral block copolymer.

1 17. The method for making a series of nanoscale microstructures according to claim 17, wherein
2 said polymerization process is a living polymerization in which monomers are sequentially
3 added to a polymerization mixture.

1 18. The method for making a series of nanoscale microstructures according to claim 12, wherein
2 said phase separation of said poly(styrene)-poly(L-lactide) chiral block copolymer is achieved
3 through crystallization.

1 19. A nanoscale process comprising the steps of:

2 (1) obtaining an object, said object contains a series of nanoscale microstructures;

3 (2) wherein said nanoscale microstructures are formed using a process containing the
4 following steps:

5
6 (A) forming a block copolymer containing a plurality of first polymer blocks and
7 a plurality of second polymer blocks, wherein said first polymer blocks are
8 chiral blocks, wherein said first polymer blocks have a volume fraction ranging
9 from 20 to 49%;

10 (B) causing a phase separation in said block copolymer.

1 20. The nanoscale process according to claim 19, wherein said block copolymer is a

2 poly(styrene)-poly(L-lactide) chiral block copolymer, and said first polymer blocks are
3 poly(L-lactide) blocks and said second polymer blocks are polystyrene blocks.